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(54) **Device and method for management and control of information generated by telematic systems onboard a vehicle**

(57) A method for handling the information generated by an info-telematic system (5a) on board a vehicle to be supplied to the driver of the vehicle through human/machine-interface apparatuses (2), the method comprising the steps of: detecting a set of parameters associated to the dynamics of the vehicle, and/or to the environment external to the vehicle, and/or to the actions of driving performed by the driver of the vehicle; estimating, on the basis of said detected parameters, a series of levels of partial risk, each of which is associated to a corresponding situation capable of modifying the level of commitment to which the driver is subject when driving the vehicle; calculating on the basis of the levels of partial risk a level of overall risk associated to the set of the situations that are likely to modify the level of commitment to which the driver is subject when driving the vehicle; establishing, according to the estimated overall level of commitment, an order in which the information coming from the on-board info-telematic system (5a) must be generated towards the user; and finally controlling the information generated by the human/machine-interface apparatuses (2) according to the established order.

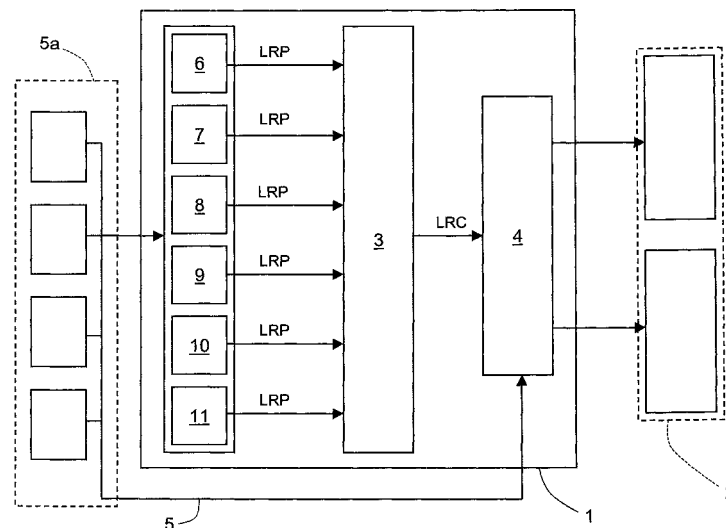


Fig.1

Description

[0001] The present invention relates to a device and to a method for management and control of the information generated by info-telematic systems on board a vehicle.

[0002] As is known, installed on vehicles of the latest generation are different types of devices and on-board info-telematic systems, which have the function of generating in regard to the driver of the vehicle, through the human/machine-interface apparatuses, information containing messages in an audio, video, or tactile format.

[0003] Unfortunately, if on the one hand currently existing human/machine-interface apparatuses and on-board info-telematic systems enable the driver to receive advantageously in real time a large amount of useful information that can facilitate the various activities performed when driving, on the other hand they inevitably cause distraction of the driver while he is driving the vehicle, thus giving rise to situations that are potentially dangerous for safe travel of the vehicle.

[0004] Consequently, in vehicles provided with on-board info-telematic systems there is increasingly felt the need for having available devices that are capable of appropriately controlling the exchange of information between the human/machine-interface apparatuses and the driver in such a way as to limit distraction of the latter as far as possible from the task of driving the vehicle.

[0005] The aim of the present invention is thus to provide a device that will be able to handle and control in an appropriate way the information generated by the info-telematic systems on board a vehicle and aimed at the driver of the vehicle in such a way as to maintain the demand on the driver's attention below an acceptable threshold.

[0006] According to the present invention, a method is provided for management and control of the information generated by the info-telematic systems on board a vehicle as specified in Claim 1 and, preferably, in any of the subsequent claims that depend directly or indirectly upon Claim 1.

[0007] According to the present invention, there is moreover provided a device for management and control of the information generated by a series of info-telematic systems on board a vehicle as specified in Claim 20.

[0008] The present invention will now be described with reference to the attached drawings, which illustrate a non-limiting example of embodiment thereof, and in which:

- Figure 1 is a schematic illustration of a device for management and control of the information generated by a series of info-telematic systems on board a vehicle built according to the teachings of the present invention;
- Figure 2 shows a first table containing an example of some processing operations and/or operations of comparison that can be implemented by a first alarm module contained in the device illustrated in Figure 1;
- Figure 3 shows a second table containing a series of reference-speed thresholds used in the operations of comparison by the first alarm module;
- Figures 4 and 5 show a first graph and, respectively, a second graph that plot the lateral acceleration and longitudinal acceleration of a vehicle and indicate the limit-of-adherence thresholds of the vehicle and the thresholds of perception of the user;
- Figure 6 shows a third table containing some limit-of-adherence thresholds of the lateral acceleration and of the longitudinal acceleration of the vehicle measured experimentally in pre-set minimum conditions of adherence;
- Figure 7 shows a fourth table containing some logic operations implemented by an alarm module of the device illustrated in Figure 1;
- Figure 8 shows a third graph that gives a series of values of speed of the vehicle measured in successive instants and used during a procedure of filtering of the speed from possible errors;
- Figure 9 shows a fifth table that gives a plurality of states of operation of some devices that co-operate with the device illustrated in Figure 1, and for each state indicates the level of partial risk to be supplied at output;
- Figure 10 is a block diagram of the information-management module included in the device illustrated in Figure 1;
- Figure 11 shows a matrix of interaction indicating a series of possible operations implemented by the device illustrated in Figure 1 for handling overlapping of information; and
- Figure 12 gives a sixth table indicating an example of the operations implemented by an information-management module for making the distinction between complex information and simple information.

[0009] With reference to Figure 1, the reference number 1 designates as a whole a device for management and control of information, which can be installed on board a vehicle (not illustrated) and is able to calculate an estimate of the level of overall risk to which a driver is subject when driving the vehicle, in such a way as to be able to control, according to the estimate calculated, the type, order and priority with which the information generated by the info-telematic devices or systems of the vehicle must be supplied to the driver through the human/machine-interface apparatuses installed on board the vehicle itself.

[0010] In particular, the device 1 for handling information is designed to estimate the level of risk on the basis of the degree of attention and of commitment to which the driver is subject, and, according to the estimate calculated, organizes and appropriately handles and controls the various information generated by the human/machine-interface apparatuses,

in such a way as not to cause for the driver any increase in the corresponding level of risk.

[0011] The device 1 for handling information is designed to receive at input a plurality of parameters which characterize the situations and events that in some way condition the level of commitment of the driver when he is driving the vehicle.

[0012] Said events can be identified, for example, on the basis of the conditions of operation of the vehicle, and/or of the external environmental conditions, and/or of the activities of driving performed by the driver, and/or of the actions performed by the driver himself on one or more devices present on board the vehicle. By processing the parameters associated to the different events and implementing a series of pre-set procedures of calculation and comparison (described in detail in what follows), the device 1 for management of information is thus able to supply an overall estimate of the risk to which the driver is subjected, and carries out, on the basis of the latter, an active control of the various information to be supplied to the driver.

[0013] In what follows, for reasons of brevity, the human/machine-interface apparatuses will be designated as HMI apparatuses 2 (where HMI is the acronym for Human/Machine Interface) and comprise a display, one or more manual and/or vocal control devices, apparatuses of a HAPTIC type, alarm apparatus of an acoustic type, devices designed to communicate to the user information in a vocal format, etc.

[0014] With reference to Figure 1, the device 1 for handling information basically comprises a plurality of alarm modules (described in detail hereinafter), each of which is capable of estimating, on the basis of a set of detected parameters, levels of partial risk, each of which is associated to a corresponding situation or event capable of modifying the level of commitment to which the driver is subject when driving the vehicle. On the basis of the estimate made, each alarm module then supplies a respective signal of risk LRP containing an indication regarding the level of partial risk estimated, deriving from the corresponding situation or event that is likely to modify the driver's attention.

[0015] The device 1 further comprises a module for evaluating the overall risk, designated in what follows, for reasons of brevity, as REM module 3 (where REM is the acronym for Risk-Evaluation Module), which has the function of calculating, on the basis of the levels of partial risk received, a level of overall risk associated to the set of the situations or events that are likely to modify the level of commitment to which the driver is subject when driving the vehicle. In the case in point, the REM module 3 processes the signals LRP to supply at output a signal LRC containing an indication regarding the level of overall risk that derives from the set of the situations or events that affect the degree of attention of the driver.

[0016] The device 1 for handling information moreover comprises an information-management module, designated in what follows, for reasons of brevity, as IM module 4 (where IM is the acronym for Information Manager), which is designed to establish, according to the estimated overall level of commitment, an order and/or a timing and/or a modality with which the information coming from the on-board info-telematic systems must be communicated to the driver, in such a way as to control generation of the information itself through the HMI apparatuses 2 according to the established order.

[0017] In particular, the device 1 is designed to receive from the REM module 3 the signal LRC and a series of supplementary items of information (described in detail hereinafter), and is able to establish according to the estimated overall level of commitment, an order and/or a timing and/or a modality with which the information coming from the on-board info-telematic systems is to be generated to the user through the HMI apparatuses 2.

[0018] In the example illustrated in Figure 1, the alarm modules are preferably, but not necessarily, connected to a communication system 5, constituted, for example, by a network or internal bus, for receiving through the latter the physical parameters that characterize the situations and the events that condition the level of commitment of the driver and hence his level of risk.

[0019] The physical parameters that characterize the situations and the events can be generated and transmitted to the communication system 5 by the various devices and by the sensors installed typically on board the vehicle for performing the different functions of measurement and/or control of the vehicle and/or assistance of the driver.

[0020] From what is described above, it should be noted that the communication system 5 is capable of communicating to the device 1 also the information coming from the various info-telematic systems 5a.

[0021] In the example illustrated in Figure 1, the alarm modules present in the device 1 comprise: a module having the function of assessing the level of partial risk deriving from the "workload" of the driver, i.e., from the degree of commitment to which the driver is subject when driving the vehicle; a module designed to evaluate the level of partial risk due to the influence on the vehicle of the events or external environmental conditions; and a module capable of evaluating the level of risk associated to the "secondary actions" not necessarily correlated to the action of driving, but performed by the driver when driving.

[0022] The alarm modules present in the device 1 moreover comprise: a module designed to estimate the risk associated to the dynamic-static conditions to which the vehicle is subjected; a module that estimates the level of partial risk deriving from the generation of information containing alarm messages warning of the danger of the vehicle moving out of a traffic lane; and finally a module designed to calculate the level of partial risk associated to the generation of alarm messages warning of a state of danger of head-on collision of the vehicle with obstacles or other vehicles.

[0023] With reference to Figure 1, the module that evaluates the level of partial risk deriving from the situation associated to the "workload" to which the user is subjected will be designated in what follows, for reasons of brevity, as DWE module

6 (where DWE is the acronym for Driver Workload Evaluation), and is designed to supply at output a level of partial risk, which quantifies the instantaneous commitment or risk deriving from the "workload" to which the driver of the vehicle is subjected when driving. The level of partial risk is determined on the basis of the driving situation associated both to the dynamics of displacement of the vehicle and to the actions and to the behaviour of the driver when driving.

[0024] It should be pointed out that hereinafter, for reasons of simplicity of description and purely by way of example, the levels of partial risk will be indicated by means of three different values, but it is evident that the number of levels of risk can be any. In the case in point, a level of partial risk to which a minimum risk is associated will be designated in what follows by first level (1st LEVEL); the level of partial risk to which an intermediate risk is associated will be designated in what follows by second level (2nd LEVEL); whilst the level of partial risk to which a maximum risk is associated will be designated in what follows by third level (3rd LEVEL).

[0025] The DWE module 6 is designed to supply at output the signal LRP containing: the first level, i.e., the level of minimum risk, when it detects a situation of reduced workload; the second level when it detects an "intermediate" workload; and finally, a third level when it detects a situation of intense workload.

[0026] The determination of the level of partial risk by the DWE module 6 can be made through a processing of a logical nature based upon the processing of a set of parameters and data associated to the driving of the driver, and/or of some parameters that characterize the dynamic behaviour of the vehicle.

[0027] In particular, the processing performed by the DWE module 6 can implement a series of operations of comparison of a logical type. For example, if from the processing of the parameters and data received it emerges that the direction light for turning to the left is lit up, the vehicle is stationary, and the front wheels are turned towards the left, then the DWE module 6 detects a condition of entry of the vehicle into the traffic flow and/or a turn to the left, and identifies a maximum workload of the driver. In this case, the DWE module 6 then assigns to the signal LRP an according level of maximum partial risk, i.e., the third level.

[0028] Processing of the DWE module 6 regarding the dynamics of the vehicle can moreover detect a condition of maximum commitment and hence a maximum risk when it detects sharp accelerations or sudden braking of the vehicle.

Said dynamic behaviour of the vehicle can be verified by the DWE module 6 by means of the processing of some parameters of operation of the vehicle, such as for example the speed, and/or the engine r.p.m., and/or the position of the accelerator pedal.

[0029] For example, the DWE module 6 can supply at output the third level of risk when it verifies at least one of the following conditions: the position of the accelerator pedal satisfies a given relation with a threshold of travel of the pedal itself (for example, the relation can be verified when the position exceeds 65% of the total travel of the pedal); and/or the angular position of the steering wheel satisfies a given relation with a pre-set angular threshold (for example, the relation can be verified when the angular position of the steering wheel is greater than or equal to 180° either in the clockwise direction or in the counterclockwise direction).

[0030] As regards, instead, the level of intermediate risk, i.e., the second level, this can be assigned, for example, to the occurrence of the following conditions: at least one direction light is on, and/or the speed of the vehicle is higher than a given speed threshold, equal for example to approximately 150 km/h, and/or the deceleration of the vehicle is greater than a pre-set threshold, equal for example to approximately 2.22 m/s².

[0031] The second level can moreover be assigned to the signal LRP when the DWE module 6 verifies that: the brake pedal is pressed and the speed of the vehicle is comprised within a pre-set range, which is in turn, for example, between 5 and 30 km/h; or else when the brake pedal is pressed and the position of the accelerator pedal, designated in what follows by P_{AC} satisfies a pre-set relation, which may be the following:

$$P_{AC} \leq -0,222 \cdot Vv^2 + 2,9412 \cdot Vv - 60,9799$$

where Vv is the speed of the vehicle.

[0032] With reference to Figure 1, the module having the function of evaluating the level of partial risk deriving from the situation regarding the influence that the external environmental conditions have on the driving of the driver and/or on the vehicle will be designated in what follows, for reasons of brevity, as EEC module 7 (where EEC is the acronym for Environmental Evaluation Criteria).

[0033] In particular, the EEC module 7 receives at input a series of items of information warning of the situation or environmental condition external to the vehicle and the dynamic behaviour of the vehicle. Said information may comprise: the speed V_v of the vehicle; the type of road travelled along by the vehicle; and/or the state of presence/absence of fog; and/or the level and amount of rain; and/or the degree of environmental light.

[0034] In the example illustrated, the values assigned to the amount, i.e., to the level of rain are three and will be designated in what follows by RAIN-1, RAIN-2 and RAIN-3, but it is evident that the amount measured and used for the

comparisons can be of any number. In the case in point, when the thickness of the film of water measured on the road surface is substantially equal to a first threshold S_1 , fixed for example at approximately 0.2 mm, the level RAIN-1 is assigned; when the thickness of the film of water is substantially equal to a second threshold S_2 , fixed for example at approximately 1 mm, the level RAIN-2 is assigned; whilst, if the thickness of the film of water is substantially equal to a third threshold S_3 , fixed for example at approximately 2 mm, the level RAIN-3 is assigned.

[0035] As regards the different parameters received by the communication system 5 and provided at input to the alarm modules, it should be pointed out that the speed of the vehicle can be supplied by one or more sensors present, for example, in the ABS system; the information regarding the presence/absence of fog can be supplied directly by a fog detector, and/or can be determined on the basis of the state of turning-on/turning-off of the foglights; and the information regarding the type of road travelled along by the vehicle can be supplied by a satellite navigation system, or else can be determined on the basis of the speed of the vehicle and of one or more tables warning of the types of roads for each speed of the vehicle.

[0036] As regards, instead, the information regarding values RAIN-1, RAIN-2 and RAIN-3 assigned to the levels of rain, they can be supplied directly to the communication system 5 by a rain-detecting sensor, or else by a control unit on the basis of the speed of actuation of the windscreen wipers. For example: the value RAIN-1 can correspond to a minimum amount of rain and be assigned when the speed of actuation of the windscreen wipers is lower than a minimum threshold; the value RAIN-2 can correspond to an intermediate amount of rain and be assigned when the speed of the windscreen wipers is comprised between the minimum threshold and a maximum threshold; whilst the value RAIN-3, indicating a large amount of rain, is assigned when the speed of the windscreen wipers selected by the driver is higher than the maximum threshold.

[0037] The information regarding the luminosity can be supplied directly to the communication system 5 by one or more light-detecting sensors, and/or on the basis of the state of activation/deactivation of the headlights of the vehicle, and/or by the day/night timetable supplied by an internal timer.

[0038] In the example illustrated, the EEC module 7 is designed to process the information at input for verifying a series of pre-set conditions so as to determine the signal LRP. Figure 2 provides, by way of example, a first table containing the instructions regarding the possible processings and/or comparisons that can be implemented by the EEC module 7 in the step of determination of the level of partial risk, where v_{s1} - v_{s10} designates speed thresholds which are to be compared with the vehicle speed measured V_v to establish, on the basis of the amount of rain, and/or of fog, and/or of the type of road (HIGHWAY, NOT HIGHWAY), and/or of the luminosity detected, the level of partial risk to be assigned.

[0039] For example, the first condition (indicated in the first row of the first table) envisages that, if the amount of rain measured is equal to RAIN-1, and the vehicle is travelling along a road corresponding to a highway and the speed measured V_v is greater than or equal to the speed threshold V_{s1} , then the EEC module 7 must supply at output a level of risk corresponding to the second level. The subsequent conditions (designated in the rows 2 to 6) envisage assigning different levels of risk according to the rain conditions, the type of road, and the results of the comparisons between the speed measured V_v and the various pre-set speed thresholds V_{s1} - V_{s6} .

[0040] The seventh and eighth conditions (indicated in the seventh and eighth rows of the first table) envisage assigning different levels of risk according to the conditions of fog (the presence of which is designated by FOG in Figure 2), the type of road, and the results of the comparisons between the speed measured V_v and the two pre-set speed thresholds V_{s7} - V_{s8} , whilst the ninth and tenth condition (indicated in the ninth and tenth rows of the first table) envisage assigning different levels of risk on the basis of the type of road and of the results of the comparisons between the speed measured V_v and the two pre-set speed thresholds v_{s9} - v_{s10} .

[0041] The speed thresholds v_{s1} - v_{s10} can be calculated through the experimental tests that envisage measurement of a coefficient of longitudinal adherence of the vehicle, designated in what follows by the coefficient μX , as the speed of the vehicle V_v varies, in the different environmental conditions. In the case in point, by means of the experimental tests it is possible to derive a series of curves that represent the plot of the coefficients of minimum longitudinal adherence μX_{min} of the vehicle as the speed varies in different environmental conditions, and to extrapolate therefrom the limit speed thresholds v_{s1} - v_{s10} . Given by way of example in Figure 3 is a second table containing some reference values obtained experimentally, which are assigned to the thresholds V_{s1} - V_{s6} by the EEC module 7 on the basis of the following information: the external environmental condition corresponding, for example, to wet-road conditions (with different amounts of rain RAIN-1, RAIN-2, RAIN-3), or dry-road conditions, or conditions of fog; the type of road (for example, NOT MOTORWAY, MOTORWAY illustrated in Figure 3); the degree of environmental luminosity (for example, daylight designated by DAYLIGHT, or nightlight designated by NIGHT).

[0042] As regards, moreover, the speed thresholds v_{s7} - v_{s10} , they can be fixed on the basis of some reference parameters established by the highway code. The values assigned to the thresholds v_{s7} - v_{s10} by the EEC module 7 may, for example, be the following:

$$v_{s7} = 16.67 \text{ m/s (60 km/h)}$$

$$v_{s8} = 13.89 \text{ m/s (50 km/h)}$$

$$v_{s9} = 41.67 \text{ m/s (150 km/h)}$$

$$v_{s10} = 25.00 \text{ m/s (90 km/h)}$$

[0043] With reference to Figure 1, the module having the function of estimating the risk associated to the conditions of dynamic/static movement of the vehicle will be designated in what follows, for reasons of brevity, as WWM module 8 (where WWM is the acronym for Weak-Warning Module) and is able to receive and process a set of parameters regarding both the dynamic behaviour of the vehicle and the external environmental conditions themselves in order to supply at output a signal LRP encoding one of the possible levels of partial risk.

[0044] In particular, the WWM module 8 has the function of calculating a signal LRP containing the partial risk deriving from the situations regarding the dynamic behaviour of the vehicle, which arise in the absence of interventions by smart systems of the ADAS type (Advanced Driver Assistance Systems), which as is known are designed to assist driving for the purpose of improving driver safety.

[0045] The parameters received at input from the WWM module 8 comprise the speed V_v of the vehicle; the ON/OFF state of the various systems for the active control of braking of the vehicle, such as the ABS system (Antilock Braking System), and/or the VDC system (Vehicle Dynamic Control); the ON/OFF state of the various systems for control of vehicle drive, such as for example the ASR system (Acceleration Slip Regulation); the external environmental temperature; the state of absence/presence of rain and, in the case of presence of rain, the amount of rain measured.

[0046] On the basis of the parameters referred to above, the WWM module 8 is able to implement a series of operations of comparison through which it determines the level of partial risk. A first operation of comparison can envisage assigning to the signal LRP the level of maximum risk corresponding to the third level in the case where one of the systems of active control of braking, such as the ABS system or the VDC system are in a condition of intervention. The condition of intervention of at least one of the systems of active control of braking (ABS, VDC) corresponds in fact to a situation of danger caused by a critical dynamic condition of the vehicle, and consequently, it is possible to conclude that the driver is subject to a condition of maximum commitment and hence of maximum risk.

[0047] A second operation of comparison implemented by the WWM module 8 can envisage assigning the second level to the signal LRP in the case where the state of activation of the system of control of drive of the vehicle ASR is detected, and the external temperature measured is lower than a minimum threshold, for example 2°C, or the presence of rain has been detected. Said operation of comparison enables detection of the situation in which the vehicle is travelling along a wet or frozen road surface, with evident danger of aquaplaning and of intermediate risk for the driver.

[0048] A third comparison operation can envisage assigning to the signal LRP the level of intermediate risk corresponding to the second level also in the case where the intervention of the ASR system of control of drive of the vehicle is verified and if the speed of the vehicle is greater than or equal to a pre-set speed threshold, for example, equal to approximately 8.33 m/s².

[0049] It should be pointed out that the WWM module 8 may be able to calculate the level of partial risk also according to the values of lateral acceleration a_{LAT} and longitudinal acceleration a_{LONG} of the vehicle. In the case in point, the WWM module 8 calculates, instant by instant, the lateral accelerations a_{LAT} and longitudinal accelerations a_{LONG} of the vehicle according to a mode of calculation described in detail hereinafter, verifies whether said values are comprised or not within respective ranges of limit adherence of the vehicle, and according to the results of said verifications assigns a given level of partial risk.

[0050] The ranges of limit adherence used during the aforesaid comparison by the WWM module 8 can be calculated by means of a series of tests executed on the vehicle, and can be represented via graphs that plot the accelerations and the thresholds of limit adherence used in the comparisons.

[0051] By way of example, Figure 4 shows a first graph of the ellipses of adherence in which the axis of the abscissa gives the lateral acceleration a_{LAT} , whilst the axis of the ordinate gives the longitudinal acceleration a_{LONG} , and in which there are indicated the limit-of-adherence thresholds of the vehicle, and the thresholds of perception by the driver of the changes of acceleration/deceleration, which also have an elliptical plot and delimit between them different areas associated to the respective levels of risk.

[0052] In particular, in the first graph of the ellipses of adherence a vehicle of a normal or sports type has been

considered, and the thresholds of perception of limit of acceleration/deceleration have been indicated in the case of normal driving or sportscar driving. For example, in the case of "normal" driving of a vehicle, the WWM module 8 assigns the level of risk on the basis of the position of the point corresponding to the accelerations a_{LAT} and a_{LONG} within the areas of the graph delimited by the thresholds. In the example illustrated, the first graph comprises: a first area associated to the first level of risk, i.e., to the level of low risk, which is represented by the space contained within an ellipse of adherence 15 (represented by a dashed line) that represents the threshold of the lateral and longitudinal accelerations/ decelerations that can be perceived by the driver; and a second area associated to the second level, i.e., to the level of intermediate risk, which is defined by the space included between the ellipse of adherence 15 and an ellipse of adherence 16 that represents the threshold of limit adherence of the vehicle beyond which the vehicle loses its adherence to the road surface.

[0053] The first graph of the ellipse of adherence illustrated in Figure 4 moreover comprises a third area associated to the third level, i.e., to the level of maximum risk, which extends on the outside of the ellipse of adherence 16 and comprises the values of longitudinal or lateral acceleration/deceleration measured in conditions of absence of adherence of the vehicle to the road surface.

[0054] In the case, instead, of driving of a "sports" vehicle, the first area of the first graph is defined by the space delimited by the ellipse of adherence 17, the second area is comprised between the ellipse of adherence 17 and the ellipse of adherence 18, whilst the third area extends beyond the ellipse of adherence 18.

[0055] With reference to Figure 5, the first graph of the ellipses of adherence can be simplified by means of a second "rectangular" graph, where the first, second and third areas are substantially rectangular instead of elliptical, and are delimited with respect to one another by the thresholds S_1 - S_5 , the numerical values of which are given in a third table illustrated in Figure 6. In particular, the first area is contained between the thresholds S_2 and S_3 , corresponding to the thresholds of lateral acceleration, and S_5 , which represents the threshold of longitudinal acceleration; the second area is delimited by the thresholds S_1 - S_2 , S_3 - S_4 and S_5 - S_6 ; whilst the third area is external to the thresholds S_1 , S_4 and S_6 .

[0056] An example of the operations implemented by the WWM module 8 for comparison of the lateral and longitudinal accelerations with the thresholds appearing in the second rectangular graph is given in the fourth table illustrated in Figure 7.

[0057] The WWM module 8 is able to make an estimate of the longitudinal acceleration a_{LONG} through a procedure of calculation of the speed of the vehicle that envisages filtering the speed itself from possible errors by means of a filter, preferably but not necessarily the constant-gain Kalman filter (α - β filter).

[0058] In particular, the constant-gain Kalman filter enables derivation of a value of speed and hence of longitudinal acceleration at each cycle of measurement of the speed itself, by performing three operations, where: a first operation makes the prediction or estimate of the speed and acceleration; a second operation measures and updates the value of the speed; whilst a third operation envisages estimation and updating of the values of acceleration and speed.

[0059] The operation of prediction envisages implementation of the following equations:

$$v_F = v + a_{LONG} \cdot \Delta t$$

$$a_F = a_{LONG}$$

where v_F is the predicted speed; v is the speed assigned; Δt is the interval of time between two measurements of speed; a_F is the value of acceleration assigned; and a_{LONG} is the value of acceleration estimated.

[0060] The step of updating of the filter follows the step of measurement of the speed v_m and comprises:

- an operation of calculation of the error of measurement of the speed according to the following relation:

$$e = v_m - v_F$$

- an operation of assignment of the speed v according to the following relation:

$$v = v_F + \alpha \cdot e$$

an operation of calculation of the longitudinal acceleration according to the following relation:

$$a_{LONG} = a_F + \frac{\beta}{\Delta t} \cdot e$$

where the coefficient α is evaluated according to the delay of the filter and is defined as the transition from 10% to 90% of the slope, whilst the coefficient β is obtained through the following relation:

$$\beta = 2(2 - \alpha) - 4\sqrt{1 - \alpha}$$

[0061] From what is described above, it should be noted that the WWM module 8 can envisage a step of initialization of the filter in which a zero value is assigned to the acceleration.

[0062] It should moreover be pointed out that the aforesaid estimate of the longitudinal acceleration a_{LONG} preferably entails a prior filtering of the measured speed. In the absence of conditioning, in fact, the variability of the longitudinal acceleration a_{LONG} estimated could be so high as to cause rapid variations of the level of partial risk. Said filtering consists in a moving-average procedure on a set of measured speed values, for example the last five values. The filtered value is equal to the average of the samples considered. In a time scale this is equivalent to having a value equal to the average of the samples positioned in an area corresponding to the central sample (i.e., the third). Following upon the measurement of a new value of speed, the first value of speed measured (the oldest) is rejected, and the new value of measured speed is inserted between the ones considered for the calculation of the average.

[0063] Figure 8 illustrates an example of the steps of the procedure: at the instant in time $t=6$ the average speed is calculated on the samples acquired in the instants from $t=2$ to $t=6$ (white dots), and its value is expressed by the grey dot, at a point corresponding to the instant in time $t=4$. At the instant $t=7$ a new value is acquired (black dot). The sample regarding the instant $t=2$ is rejected, and the new value is used for calculation of the new average speed (the time window represented dashed in Figure 7 shifts to the right).

[0064] The value of longitudinal acceleration is assumed as being equal to the incremental ratio between speed and time. The increase in speed is calculated between the last value acquired and the moving average at the previous step, whilst the time increase is equal to the distance between the instant of acquisition of the last value and the instant in which the averaged value is located. For example, with reference to Figure 8, the increase in speed at the instant $t=7$ is given by the difference of ordinate between the black and grey dots, whilst the time increase is equal to three times the unit interval Δt .

[0065] With reference to Figure 1, the module capable of evaluating the level of risk associated to the situations or events deriving from "secondary actions", will be designated in what follows, for reasons of brevity, as DSA module 9 (where DSA is the acronym for Driver Secondary Activity).

[0066] In particular, the DSA module 9 supplies at output the signal LRP containing the level of partial risk associated to the secondary activities not directly inherent in driving of the vehicle, but associated to the use of "secondary" devices having the function of drawing the driver's attention through messages of a visual, vocal or tactile type. The secondary devices may, for example, be the car radio, the satellite navigation system, devices for telephone communications, the dashboard, the keypads or the control devices associated to the central display or any other similar type of on-board device of the vehicle.

[0067] The DSA module 9 is able to recognize an operating state of the secondary device or an action performed thereon by the driver, and according to said detection identifies in a pre-set table a corresponding level of partial risk to be assigned to the signal LRP.

[0068] The example of Figure 9 is a schematic illustration of a table indicating, for each of the secondary devices (some of which are indicated in the first column on the left) and for each operating state (some of which are indicated in the central column) of the secondary device, a level of risk to be assigned to the signal LRP (indicated in the column on the right).

[0069] With reference to Figure 9, for example, if the DSA module 9 detects a state of phone call in progress made by a telephone device, then it supplies at output the second level, keeping it temporarily for a pre-set duration also at the end of the phone call (for example, for a duration of two seconds at the end of the call).

[0070] If, instead, the DSA module 9 detects a state of reception of a phone call, then it assigns to the signal LRP the second level during acoustic signalling of the call warning. If, instead, the DSA module 9 detects a state of start of telephone connection, then it assigns the second level to the signal LRP for the entire period of connection. In this case, if the phone call is accepted, the DSA module 9 verifies the condition of call in progress and carries out the actions described above, whereas if the phone call is refused or is interrupted, or the line is engaged, the DSA module 9 supplies at output the second level for a couple of seconds after system notification.

[0071] In the case where the DSA module 9 verifies reception of a telephone message in text format (SMS or other text information of various types), a second level of partial risk is supplied for three seconds after notification of the message. If the DSA module 9 detects from the input devices of the central display a state of activation or command pushbutton having been pressed, the second level of risk is supplied at output and is maintained for ten seconds starting from the action of pressure performed on the key, whereas if pressure or rotation of a rotary pushbutton is detected (for example for tuning to a radio channel or adjusting the volume), the second level of risk is supplied and is maintained for ten seconds starting from the end of the action performed.

[0072] Finally, if the DSA module 9 detects display of a message in the instrument panel, then it supplies at output the signal LRP containing the second level for the entire period of time of display.

[0073] From what is described above, it should be noted that in the case where the DSA module 9 receives at input at the same instant a number of items of information regarding the state of activation of a secondary device, then it can implement a logic criterion for determination of the level of risk to be assigned to the signal LRP.

[0074] Said logic criterion can envisage that, in the case where different conditions arise associated to different levels of risk to be assigned to the signal LRP, the higher level of risk prevails and hence is assigned. For instance, if at least one of the levels of risk corresponding to the conditions regarding the secondary devices corresponds to the second level and all the others have a lower level, then the second level will be assigned to the signal LRP.

[0075] As regards the module 10, this is able to estimate the level of partial risk (also this being articulated on a number of levels) on the basis of a series of items of information that contain alarm messages warning of the condition of accidental exit of the vehicle from a traffic lane. Said messages are provided at input to the module 10 by a known system, which detects, instant by instant, the position of the vehicle with respect to the lane, and warns, on the basis of said detection, the possible risk of exit of the vehicle itself (articulated on a number of levels).

[0076] Finally, as regards the module 11, this is designed for calculating the level of partial risk (articulated on a number of levels according to the potential degree of seriousness) on the basis of a series of items of information containing alarm messages warning of the possibility of head-on collision of the vehicle with obstacles or with other vehicles. In the case in point, said alarm messages are provided at input to the module 11 by a system that detects, instant by instant, the presence of potential obstacles or other vehicles running the risk of potential collision present in the lane facing the vehicle.

[0077] With reference to Figure 1, as already mentioned previously, the REM module 3 receives the signals LRP supplied by the alarm modules 6-11 described above and processes them to supply to the IM module 4 the signal LRC indicating a level of overall risk.

[0078] In particular, the REM module 3 is designed to handle the levels of partial risk contained in the input signals to be able to interpret them according to a single scale of standard levels of risk. In other words, each alarm module 6-11 may be able to assign to the corresponding signal LRP any number N of levels of risk (even other than the three levels described above) with M intermediate levels comprised between a maximum value and a minimum value of risk, and the REM module 3 is able to "convert" the N levels into a scale of common levels of risk comprising L levels of risk.

[0079] In order to convert the N levels of input of the signals LRP into a scale with L common levels of risk, the REM module 3 can implement a procedure that envisages, for example, assigning the level of maximum risk of the common scale when the level of risk of the signal LRP is the highest of the ones assignable by the alarm module, or else assigning the level of minimum risk of the common scale when the level of risk of the signal LRP is the lowest of the ones assignable by the alarm module. Alternatively, in the case where the level of risk of the signal is intermediate, the REM module 3 calculates the level of risk of the scale through a pre-set algebraic relation.

[0080] The level of overall risk assignable to the signal LRC by the REM module 3 can assume K levels that comprise a level of maximum overall risk in the case of a serious and imminent risk, a level of overall minimum risk in the case of normal and not imminent risk and a series of K-2 intermediate levels of risk.

[0081] In the example illustrated K=4, and the level 1 corresponds to the condition of maximum risk, the level 4 corresponds to the situation of normal i.e., minimum risk, and the levels 2 and 3 designate intermediate levels of risk. Determination of the level of overall risk by the REM module 3 on the basis of the signals LRP is made through a series of logic operations which can envisage a verification of the conditions described in what follows.

[0082] A first condition can envisage that if at least one level of maximum risk is detected between all the signals LRP received at input by the REM module 3, then the signal LRC assumes the level of overall maximum risk, which, in the example illustrated, corresponds to the level 1.

[0083] A second condition can, instead, envisage that in the case where all the levels of risk received at input correspond

to the level of minimum risk, the REM module 3 assigns to the signal LRC the level of minimum risk.

[0084] A third condition can, instead, envisage that if the REM module 3 receives at input intermediate levels of partial risk, i.e., level 2 or level 3, and one or more minimum levels of risk, i.e., level 4, calculates a "weighted" sum of the M levels of risk received, and determines the level of overall risk on the basis of the results of a comparison between the "weighted" sum and a pre-set threshold K. In particular, the third condition can envisage that the REM module 3 initially assigns to each level of partial risk a respective "weight" P_w . In the case in point, assigned to the level 2 is the weight $P_w = 2$, assigned to the level 3 is the weight $P_w = 1$, whilst assigned to the level 1 is the weight $P_w = 0$. Following upon assignment of the weights P_w , the REM module 3 calculates the "weighted" sum S of the M levels of risk received at input by means of the following relation:

$$S = \sum_{i=1}^M x(i)P_w$$

where $x(i)$ (with i ranging from 1 to M) is the level of partial risk received at input and/or converted into the common scale of the levels. The assignment criterion associated to the third condition finally envisages comparing the "weighted" sum S with the pre-set threshold K and assigning the level of overall risk according to said comparison. For example, if the pre-set threshold is $K=2$, the third condition can envisage assigning the level 2 of overall risk when the condition $S \geq K$ is satisfied, or alternatively assigns the level of risk 3 when the condition $S < K$ is satisfied.

[0085] As regards the IM module 4, this is able to implement a first series of operations that envisage determining, instant by instant, on the basis of the level of overall risk calculated by the REM module 3 and of a priority assigned to the information, what is the order in which the information coming from the info-telematic systems 5a have to be supplied to the driver through the HMI apparatuses 2.

[0086] The IM module 4 is moreover capable of implementing a second series of operations designed to handle the condition of instantaneous overlapping between a number of items of information designed to be supplied simultaneously at output to the driver, and a third series of operations, through which for each item of information there is established what is the optimal format through which the information itself is to be generated in regard to the driver via the HMI apparatuses 2.

[0087] In the example illustrated in Figures 1 and 10, the IM module 4 receives at input: the signal LRC containing the level of overall risk calculated by the REM module 3; a series of signals containing the information generated by the info-telematic systems 5a; and preferably, but not necessarily, the signals provided by the ADAS devices or systems that may be present on board the vehicle. Said signals comprise the information aimed at the user that the IM module 4 must handle before sending it to the HMI devices 2. This information is treated by the IM module 4 in the way described hereinafter.

[0088] In particular, the IM module 4 comprises: a block 4a for generation of information designed to assign a priority to each item of information; a block 4b, designed to store the new information supplied at output from the module 4a; a block 4c having the function of temporarily storing the information set in a wait state; a block 4d having the function of storing the information set in a state of temporary suspension; a block 4e having the function of fetching the information present in the blocks 4b-4d to supply it at output according to a pre-set criterion (described in detail hereinafter); and a block 4f having the function of handling overlapping of the information and of assigning an optimal format to the information to be supplied to the driver.

[0089] In the example illustrated, the block 4a for generation of the information receives at input all the information produced by the info-telematic systems 5a, and assigns to each item of information received a given level of priority P_i , and then supplies the information itself to the block 4e, which in turn envisages organizing and handling the order in which each item of information must be supplied to the driver.

[0090] The block 4e receives at input the signal LRC containing the level of overall risk calculated by the REM module 3, and, according to the latter and on the basis of the priority of the information, envisages cyclic fetching of the information stored in the blocks 4b, 4c and 4d to supply them at output according to a pre-set processing procedure.

[0091] In particular, the procedure implemented by the block 4e can envisage that, if the level of overall risk corresponds to the level 1, i.e., to the level of maximum risk, then there is fetched from the blocks 4b, 4c and 4d and supplied at output therefrom only the information having the maximum priority associated, for example, to a condition of extreme urgency correlated to a state that is critical for driver safety.

[0092] If, instead, during the procedure implemented by the block 4e it is verified that the level of overall risk corresponds to the level 2, i.e., to a first level of intermediate risk, then the information having a high priority (lower than the maximum priority) and associated, for example, to a condition of particular urgency and importance is supplied at output. If, instead, during the procedure implemented by the block 4e it is verified that the level of overall risk corresponds to the level 3,

i.e., to a second level of intermediate risk, then the information having a medium priority and associated, for example, to a condition of medium importance is supplied at output.

[0093] Finally, if during the procedure implemented by the block 4e it is verified that the level of overall risk corresponds to the level 4, i.e., to the level of minimum risk, all the information irrespective of its priority is then supplied at output.

[0094] As regards the block 4f, this receives at input the information ordered by the block 4e and envisages handling of both overlapping of the information to be supplied at output and its format, i.e., the modality with which it is to be supplied to the driver by means of the HMI apparatuses 2.

[0095] In particular, the block 4f is able to establish the timing with which each item of information is to be supplied at output, in the case where there arises an overlapping of a number of items of information. An example of the procedure implemented by the block 4f appears in the matrix of interaction illustrated in Figure 11, in which it is indicated that in the case where there arises overlapping between one previous message having a maximum priority and a new message having a maximum priority, both will be supplied at output at the same instant. The interaction matrix can moreover envisage that, if there occurs overlapping between a previous message having maximum priority (for example priority 1 in the example illustrated) and a new message having a lower priority (for example, priority 2 in the example illustrated), then the latter is supplied at output with a pre-set delay with respect to the instant of communication of the first message.

[0096] The block 4f moreover has the function of establishing, according to a pre-set criterion, the format, i.e., the modality and the communication channel, through which the message is to be supplied at output to the driver. Said criterion can envisage supplying the information in an audio format if the information comprises, for example, a message that is simple, of short duration and does not require the user to refer to it in a medium-to-long period (which is defined on the basis of appropriate pre-set ergonomic criteria), or else in a visual format if the information comprises, for example, a complex message or if the message is simple but requires the user to refer to it in a medium-to-long period.

[0097] Said criterion can moreover envisage supplying the information in a multimode format, i.e., in an audio, and/or video, and/or tactile format, if the message is to attract the attention of the driver (for example, in the case of a signal of alarm or alert) or if the information regards the communication of simple messages and simultaneously of complex messages.

[0098] From what is described above, it should be noted that for the purpose of identifying the optimal format, the block 4f of the IM module 4 is able to distinguish the information regarding the simple messages from that containing complex messages. Said distinction is made by the block 4f according to two parameters, the first one of which, referred to as information unit, indicates the degree of complexity associated to the information, and the second of which regards the time necessary for processing said information and supplying it at output. Figure 12 provides a sixth table indicating an example of the operations that can be implemented by the IM module 4 for distinguishing complex information from simple information. In the case in point with reference to the sixth table, the IM module 4 identifies the information containing a complex message when the information units are higher than a numerical threshold equal to 3 and the processing time is longer than three seconds, whilst it identifies the information containing a simple message when the information units are comprised between the values 1 and 4 and the processing time is shorter than the time threshold of three seconds.

[0099] The advantages of the present device 1 for management and control of information are evident from what is described above. In fact, the device 1 presents the major advantage of co-ordinating the information generated by the info-telematic systems and addressed to the driver in such a way as to provide an indirect control proper of the level of commitment of the driver, which is kept constantly below a threshold limit, with obvious advantages as regards driving safety.

[0100] Finally, it is clear that modifications and variations may be made to the system described and illustrated herein, without thereby departing from the scope of the present invention.

Claims

1. A method for handling information generated by at least one info-telematic system (5a) on board a vehicle and designed to be supplied to the driver of the vehicle through means of human/machine interface (2); said method being **characterized in that** it comprises the steps of:

- detecting a set of parameters associated to the dynamics of the vehicle, and/or to the environment external to the vehicle, and/or to the actions of driving performed by the driver of the vehicle, and/or to the actions performed by the driver himself on one or more devices present on board the vehicle;
- estimating, on the basis of said detected parameters a series of levels of partial risk, each of which is associated to a corresponding situation capable of modifying the level of commitment to which the driver is subject when driving the vehicle;
- calculating, on the basis of the levels of partial risk, a level of overall risk associated to the set of the situations

that are likely to modify the level of commitment to which the driver is subject when driving the vehicle;

- establishing, according to the estimated level of overall commitment, what information coming from the on-board info-telematic system (5a) to supply to the user, in what order, and/or in what mode, and or according to what timing; and

- accordingly controlling the information supplied to the driver through said means of human/machine interface (2).

2. The method according to Claim 1, **characterized in that** it comprises the step of assigning a priority to each item of information coming from the on-board info-telematic system (5a); and **in that** it establishes the order in which each item of information is to be supplied to the user according to the priority assigned to the information itself.

3. The method according to Claim 2, **characterized in that** said step of establishing the order in which the information is to be supplied to the user comprises the step of establishing the instant in time and/or the format in which each item of information is to be supplied to the user himself.

4. The method according to Claim 3, **characterized in that** the format of each item of information is established according to the degree of complexity of the information itself.

5. The method according to Claim 4, **characterized in that** the format by means of which each item of information is supplied to the driver through said means of human/machine interface (2) comprises an audio, and/or video, and/or tactile and/or multimode format.

6. The method according to any one of the preceding claims, **characterized in that** it comprises the step of controlling overlapping of a number of items of information designed to be supplied simultaneously to the driver, according to the priority of each said item of information.

7. The method according to any one of the preceding claims, **characterized in that** said step of calculating a level of overall risk comprises the step of assigning to the level of overall risk a maximum value if at least one of said levels of partial risk calculated has a pre-set value of maximum risk.

8. The method according to any one of the preceding claims, **characterized in that** said step of calculating a level of overall risk comprises the step of assigning to the level of overall risk a maximum value if a given number of levels of partial risk calculated have a pre-set value of maximum risk.

9. The method according to any one of the preceding claims, **characterized in that** said step of calculating a level of overall risk comprises the step of assigning to the level of overall risk a minimum value if a given number of levels of partial risk calculated have a minimum value.

10. The method according to any one of the preceding claims, **characterized in that** said step of estimating a series of levels of partial risk comprises the step of assigning a value of partial risk according to the workload to which the driver is subjected when driving.

11. The method according to Claim 10, **characterized in that** the value of risk assigned according to the workload to which the driver is subjected is determined according to a set of parameters associated to the mode of driving of the driver, and to the dynamic behaviour of the vehicle.

12. The method according to any one of the preceding claims **characterized in that** said step of estimating a series of levels of partial risk comprises the step of assigning a value of risk according to the conditions of dynamic/static movement of the vehicle, and/or of a set of parameters regarding the environmental conditions external to the vehicle itself.

13. The method according to Claim 12, **characterized in that** the value of risk corresponding to the conditions of dynamic/static movement of the vehicle is determined according to the speed of the vehicle, and/or to the ON/OFF state of the systems for the active control of braking of the vehicle, and/or to the ON/OFF state of the systems for control of vehicle drive, and/or to the external environmental temperature, and/or to the condition of absence/presence of rain, and/or to the amount of rain measured, and/or to the degree of external environmental luminosity.

14. The method according to Claims 12 and 13,

characterized in that it determines the value of risk associated to the conditions of dynamic/static movement of the vehicle according to the values of lateral acceleration (a_{LAT}) and of longitudinal acceleration (a_{LONG}) of the vehicle.

- 5 **15.** The method according to Claim 14, **characterized in that** it comprises the step of estimating the longitudinal acceleration (a_{LONG}) through an operation of filtering of the speed of the vehicle from possible errors.
- 16.** The method according to any one of the preceding claims, **characterized in that** said step of estimating a series of levels of partial risk, comprises the step of assigning a value of risk according to a series of secondary activities not directly inherent in the driving of the vehicle, but associated to the use of "secondary" devices having the function of drawing the attention of the driver through messages of a visual, vocal or tactile type.
- 17.** The method according to any one of the preceding claims, **characterized in that** said step of estimating a series of levels of partial risk comprises the step of assigning a value of risk according to a series of items of information containing alarm messages warning that the vehicle has accidentally exited from a pre-set traffic lane.
- 18.** The method according to any one of the preceding claims, **characterized in that** said step of estimating a series of levels of partial risk comprises the step of assigning a value of risk according to a series of items of information containing alarm messages warning of the possibility of head-on collision of the vehicle with an obstacle.
- 20 **19.** The method according to any one of the preceding claims, **characterized in that** it supplies or otherwise each item of information according to the priority of the information and of the estimated overall level of commitment.
- 25 **20.** A device (1) for management and control of information generated by at least one info-telematic system (5a) on board a vehicle, which is configured for implementing the method according to any one of the preceding claims.

Amended claims in accordance with Rule 86(2) EPC.

30 **1.** A method for managing supply of information to a driver of a road vehicle through a human/machine interface (2), wherein said information is generated by applications, such as radio, a phone, satellite navigation system, of an on-board telematic system (5a) of said road vehicle; said method being **characterized in that** it comprises the steps of:

- 35 - detecting a set of parameters associated to the dynamics of the vehicle, and/or to the environment external to the vehicle, and/or to the actions of driving performed by the driver of the vehicle, and/or to the actions not necessarily correlated to the action of driving, but performed by the driver when driving, on one or more devices present on board the vehicle;
- 40 - estimating, on the basis of said detected parameters a series of levels of partial risk, each of which is associated to a corresponding situation capable of modifying the level of commitment to which the driver is subject when driving the vehicle;
- calculating, on the basis of the levels of partial risk, a level of overall risk associated to the set of the situations that are likely to modify the level of commitment to which the driver is subject when driving the vehicle;
- 45 - establishing, according to the estimated level of overall commitment, what information coming from said applications of said on-board telematic system (5a) to supply to the driver, in what order, and/or in what mode, and or according to what timing; and
- accordingly controlling the supply to the driver of information generated by said applications of said on-board telematic system (5a).

50 **2.** The method according to Claim 1, **characterized in that** it comprises the step of assigning a priority to each item of information coming from the on-board vehicle telematic system (5a); and **in that** it establishes the order in which each item of information is to be supplied to the driver according to the priority assigned to the information itself.

55 **3.** The method according to Claim 2, **characterized in that** said step of establishing the order in which the information is to be supplied to the driver comprises the step of establishing the instant in time and/or the format in which each item of information is to be supplied to the driver himself.

4. The method according to Claim 3, **characterized in that** the format of each item of information is established according to the degree of complexity of the information itself.

5. The method according to Claim 4, **characterized in that** the format by electric means of which each item of information is supplied to the driver through said human/machine interface (2) comprises an audio, and/or video, and/or tactile and/or multimode format.

6. The method according to any one of the preceding Claims, **characterized in that** it comprises the step of controlling overlapping of a number of items of information designed to be supplied simultaneously to the driver, according to the priority of each said item of information.

7. The method according to any one of the preceding Claims, **characterized in that** said step of calculating a level of overall risk comprises the step of assigning to the level of overall risk a maximum value if at least one of said levels of partial risk calculated has a pre-set value of maximum risk.

8. The method according to any one of the Claims 1 to 6, **characterized in that** said step of calculating a level of overall risk comprises the step of assigning to the level of overall risk a maximum value if a given number of levels of partial risk calculated have a pre-set value of maximum risk.

9. The method according to any one of the Claims 1 to 6, **characterized in that** said step of calculating a level of overall risk comprises the step of assigning to the level of overall risk a minimum value if a given number of levels of partial risk calculated have a minimum value.

10. The method according to any one of the preceding Claims, **characterized in that** said step of estimating a series of levels of partial risk comprises the step of assigning a value of partial risk according to the workload to which the driver is subjected when driving.

11. The method according to Claim 10, **characterized in that** the value of risk assigned according to the workload to which the driver is subjected is determined according to a set of parameters associated to the mode of driving of the driver, and to the dynamic behaviour of the vehicle.

12. The method according to any one of the Claims 1 to 9, **characterized in that** said step of estimating a series of levels of partial risk comprises the step of assigning a value of risk according to the conditions of dynamic/static movement of the vehicle, and/or of a set of parameters regarding the environmental conditions external to the vehicle itself.

13. The method according to Claim 12, **characterized in that** the value of risk is determined according to the speed of the vehicle, and/or to the ON/OFF state of the systems for the active control of braking of the vehicle, and/or to the ON/OFF state of the systems for control of vehicle drive, and/or to the external environmental temperature, and/or to the condition of absence/presence of rain, and/or to the amount of rain measured, and/or to the degree of external environmental luminosity.

14. The method according to Claims 12 and 13, **characterized in that** it determines the value of risk associated to the conditions of dynamic/static movement of the vehicle according to the values of lateral acceleration (a_{LAT}) and of longitudinal acceleration (a_{LONG}) of the vehicle.

15. The method according to Claim 14, **characterized in that** it comprises the step of estimating the longitudinal acceleration (a_{LONG}) through an operation of filtering of the speed of the vehicle from possible errors.

16. The method according to any one of the Claims 1 to 9, **characterized in that** said step of estimating a series of levels of partial risk, comprises the step of assigning a value of risk according to a series of secondary activities not directly inherent in the driving of the vehicle, but associated to the use of secondary devices having the function of drawing the attention of the driver through messages of a visual, vocal or tactile type.

17. The method according to any one of the Claims 1 to 9, **characterized in that** said step of estimating a series of levels of partial risk comprises the step of assigning a value of risk according to a series of items of information containing alarm messages warning that the vehicle has accidentally exited from a pre-set traffic lane.

18. The method according to any one of the Claims 1 to 9, **characterized in that** said step of estimating a series of levels of partial risk comprises the step of assigning a value of risk according to a series of items of information containing alarm messages warning of the possibility of head-on collision of the vehicle with an obstacle.

19. The method according to any one of the preceding Claims, **characterized in that** it supplies or otherwise each item of information according to the priority of the information and of the estimated overall level of commitment.

20. A device (1) for managing and controlling supply of information to a driver of a road vehicle through a human/machine interface (2), wherein said information is generated by applications, such as radio, phone, satellite navigation system, of an on-board telematic system (5a) of said road vehicle; said device being **characterized by** comprising:

- detection means configured to detect a set of parameters associated to the dynamics of the vehicle, and/or to the environment external to the vehicle, and/or to the actions of driving performed by the driver of the vehicle, and/or to the actions not necessarily correlated to the action of driving, but performed by the driver when driving, on one or more devices present on board the vehicle;
- estimation means configured to estimate, on the basis of said detected parameters a series of levels of partial risk, each of which is associated to a corresponding situation capable of modifying the level of commitment to which the driver is subject when driving the vehicle;
- calculation means configured to calculate, on the basis of the levels of partial risk, a level of overall risk associated to the set of the situations that are likely to modify the level of commitment to which the driver is subject when driving the vehicle;
- establishing means configured to establish, according to the estimated level of overall commitment, what information coming from said applications of said on-board telematic system (5a) of said vehicle to supply to the user, in what order, and/or in what mode, and or according to what timing; and
- control means configured to control supply to the driver of information generated by said applications of said on-board telematic system (5a).

21. Device according to Claim 20, **characterized in that** it comprises means for assigning a priority to each item of information coming from the on-board vehicle telematic system (5a); and **in that** said establishing means are configured to establish the order in which each item of information is to be supplied to the driver according to the priority assigned to the information itself.

22. Device according to Claim 21, **characterized in that** said establishing means are configured to establish the instant in time and/or the format in which each item of information is to be supplied to the driver.

23. Device according to Claim 22, **characterized in that** said establishing means are configured to establish the format of each item of information according to the degree of complexity of the information itself.

24. Device according to Claims 23, **characterized in that** said human/machine interface (2) is configured to supply the information to the driver in a format comprise an audio, and/or video, and/or tactile and/or multimode format.

25. Device according to any one of the Claims 20 to 24, **characterized in that** it comprises means for controlling overlapping of a number of items of information designed to be supplied simultaneously to the driver, according to the priority of each said item of information.

26. Device according to any one of the Claims 20 to 25, **characterized in that** said calculation means are configured to assign to the level of overall risk a maximum value if at least one of said levels of partial risk calculated has a pre-set value of maximum risk.

27. Device according to any one of the Claims 20 to 25, **characterized in that** said calculation means are configured to assign to the level of overall risk a maximum value if a given number of levels of partial risk calculated have a pre-set value of maximum risk.

28. Device according to any one of the Claims 20 to 25, **characterized in that** said calculation means are configured to assign to the level of overall risk a minimum value if a given number of levels of partial risk calculated have a minimum value.

29. Device according to any one of the Claims 20 to 28, **characterized in that** said estimation means are configured to assign a value of partial risk according to the workload to which the driver is subjected when driving.

30. Device according to any one of the Claims 20 to 28, **characterized in that** said estimation means are configured to assign a value of partial risk according to a set of parameters associated to the mode of driving of the driver, and

to the dynamic behaviour of the vehicle.

31. Device according to any one of the Claims 20 to 28, **characterized in that** said estimation means are configured to assign a value of risk according to the conditions of dynamic/static movement of the vehicle, and/or of a set of parameters regarding the environmental conditions external to the vehicle itself.

32. Device according to any one of the Claims 20 to 28, **characterized in that** said estimation means are configured to determine a value of risk according to the speed of the vehicle, and/or to the ON/OFF state of the systems for the active control of braking of the vehicle, and/or to the ON/OFF state of the systems for control of vehicle drive, and/or to the external environmental temperature, and/or to the condition of absence/presence of rain, and/or to the amount of rain measured, and/or to the degree of external environmental luminosity.

33. Device according to Claims 31 and 32, **characterized in that** estimation means are configured to determine a value of risk associated to the conditions of dynamic/static movement of the vehicle according to the values of lateral acceleration (a_{LAT}) and of longitudinal acceleration (a_{LONG}) of the vehicle.

34. Device according to Claim 33, **characterized in that** said estimation means are configured to estimate the longitudinal acceleration (a_{LONG}) through an operation of filtering of the speed of the vehicle from possible errors.

35. Device according to any one of the Claims 20-28, **characterized in that** said estimation means are configured to assign a value of risk according to a series of secondary activities not directly inherent in the driving of the vehicle, but associated to the use of secondary devices having the function of drawing the attention of the driver through messages of a visual, vocal or tactile type.

36. Device according to any one of the Claims 20-28, **characterized in that** said estimation means are configured to assign a value of risk according to a series of items of information containing alarm messages warning that the vehicle has accidentally exited from a pre-set traffic lane.

37. Device according to any one of the preceding Claims 20 to 28, **characterized in that** said estimation means are configured to assign a value of risk according to a series of items of information containing alarm messages warning of the possibility of head-on collision of the vehicle with an obstacle.

38. Vehicle telematic system on board of a road vehicle comprising a device (1) for managing and controlling the supply of information to the driver of the road vehicle through human/machine interface (2), in which said information is generated by applications, such as radio, or phone, or satellite navigation system of the vehicle telematic system (5a) on board a said vehicle; said vehicle telematic system being **characterized in that** said device is realized according to any one of the Claims 20 to 37.

39. Road vehicle comprising a device (1) for managing and controlling the supply of information to the driver of the road vehicle through human/machine interface (2), in which said information is generated by applications, such as radio, or phone, or satellite navigation system of a vehicle telematic system (5a) on board a said vehicle; said road vehicle being **characterized in that** said device (1) is realized according to any one of the Claims 20 to 37.

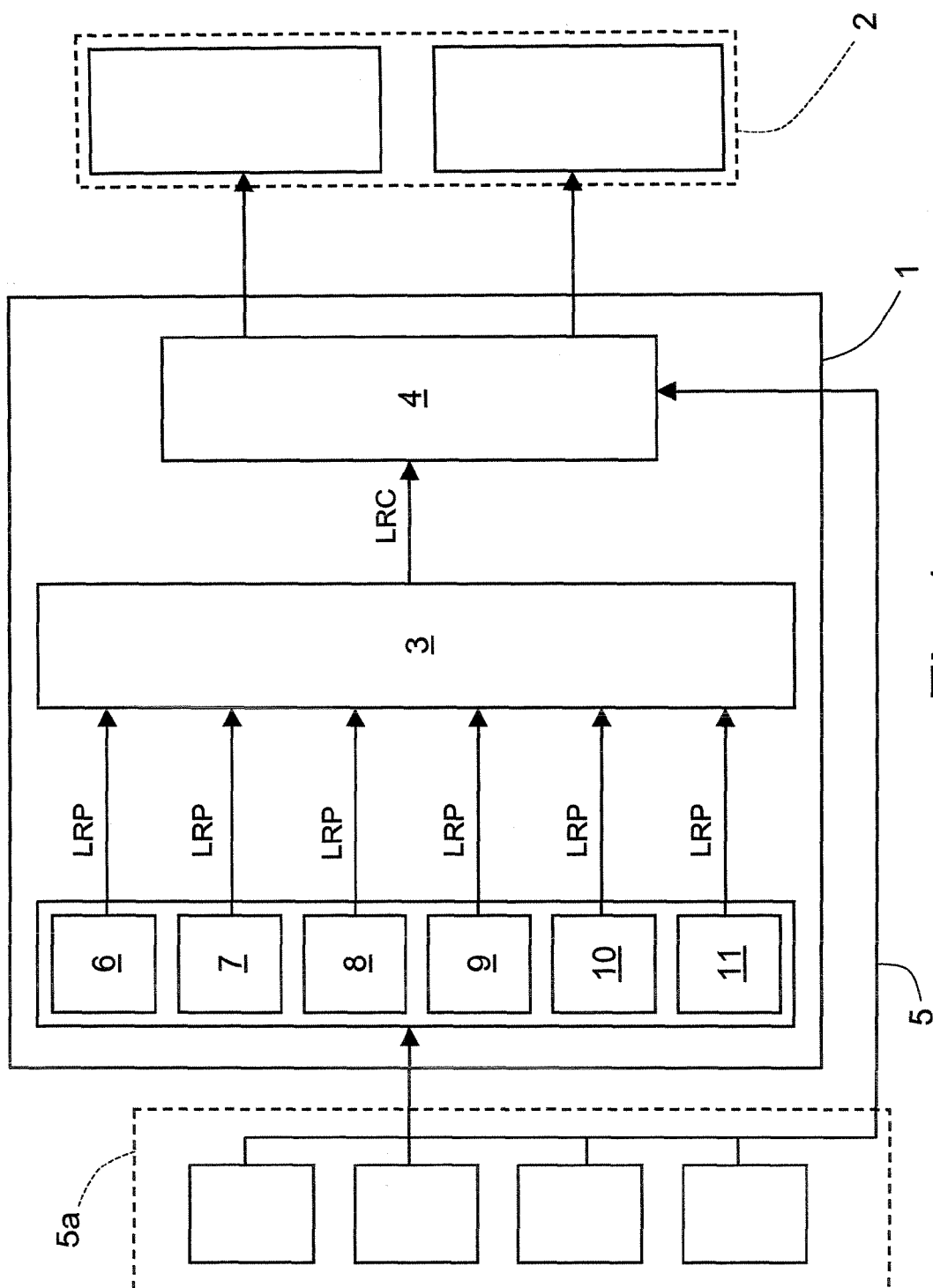


Fig.1

1.	if RAIN-1 AND HIGHWAY AND $v_v \geq v_{s1}$ then LRP=2 ND LEVEL
2.	if RAIN-1 AND NOT HIGHWAY AND $v_v \geq v_{s2}$ then LRP=2 ND LEVEL
3.	if RAIN-2 AND HIGHWAY AND $v_v \geq v_{s3}$ then LRP=2 ND LEVEL
4.	if RAIN-2 AND NOT HIGHWAY AND $v_v \geq v_{s4}$ then LRP=2 ND LEVEL
5.	if RAIN-3 AND HIGHWAY AND $v_v \geq v_{s5}$ then LRP=3 RD LEVEL
6.	if RAIN-3 AND NOT HIGHWAY AND $v_v \geq v_{s6}$ then LRP=3 RD LEVEL
7.	if FOG AND $v_v \geq v_{s7}$ AND HIGHWAY then LRP=3 RD LEVEL
8.	if FOG AND $v_v \geq v_{s8}$ AND NOT HIGHWAY then LRP=3 RD LEVEL
9.	if $v_v \geq v_{s9}$ AND HIGHWAY then LRP=2 ND LEVEL
10.	if $v_v \geq v_{s10}$ AND NOT HIGHWAY then LRP=2 ND LEVEL

Fig.2

N	WEATHER CONDITION	TYPE OF ROAD	LIGHT CONDITION	PARAMETER VALUE [km/h] (m/sec)
1	RAIN 1	MOTORWAYS	DAYLIGHT	$v_{s1} = 100 (\equiv 27.78)$
			NIGHT	$v_{s1} = 90 (\equiv 25.00)$
2	RAIN 1	NOT MOTORWAYS	DAYLIGHT	$v_{s2} = 60 (\equiv 16.67)$
			NIGHT	$v_{s2} = 50 (\equiv 13.89)$
3	RAIN 2	MOTORWAYS	DAYLIGHT	$v_{s3} = 100 (\equiv 27.78)$
			NIGHT	$v_{s3} = 90 (\equiv 25.00)$
4	RAIN 2	NOT MOTORWAYS	DAYLIGHT	$v_{s4} = 70 (\equiv 19.44)$
			NIGHT	$v_{s4} = 60 (\equiv 16.67)$
5	RAIN 3	MOTORWAYS	DAYLIGHT	$v_{s5} = 80 (\equiv 22.22)$
			NIGHT	$v_{s5} = 70 (\equiv 19.44)$
6	RAIN 3	NOT MOTORWAYS	DAYLIGHT	$v_{s6} = 70 (\equiv 19.44)$
			NIGHT	$v_{s6} = 60 (\equiv 16.67)$
7	FOG	MOTORWAYS	DAYLIGHT	$v_{s1} = 60 (\equiv 16.67)$
			NIGHT	$v_{s1} = 50 (\equiv 13.89)$
8	FOG	NOT MOTORWAYS	DAYLIGHT	$v_{s1} = 50 (\equiv 13.89)$
			NIGHT	$v_{s1} = 40 (\equiv 11.11)$
9	DRY	MOTORWAYS	DAYLIGHT	$v_{s1} = 150 (\equiv 41.67)$
			NIGHT	$v_{s1} = 140 (\equiv 38.89)$
10	DRY	NOT MOTORWAYS	DAYLIGHT	$v_{s1} = 90 (\equiv 25.00)$
			NIGHT	$v_{s1} = 80 (\equiv 22.22)$

Fig.3

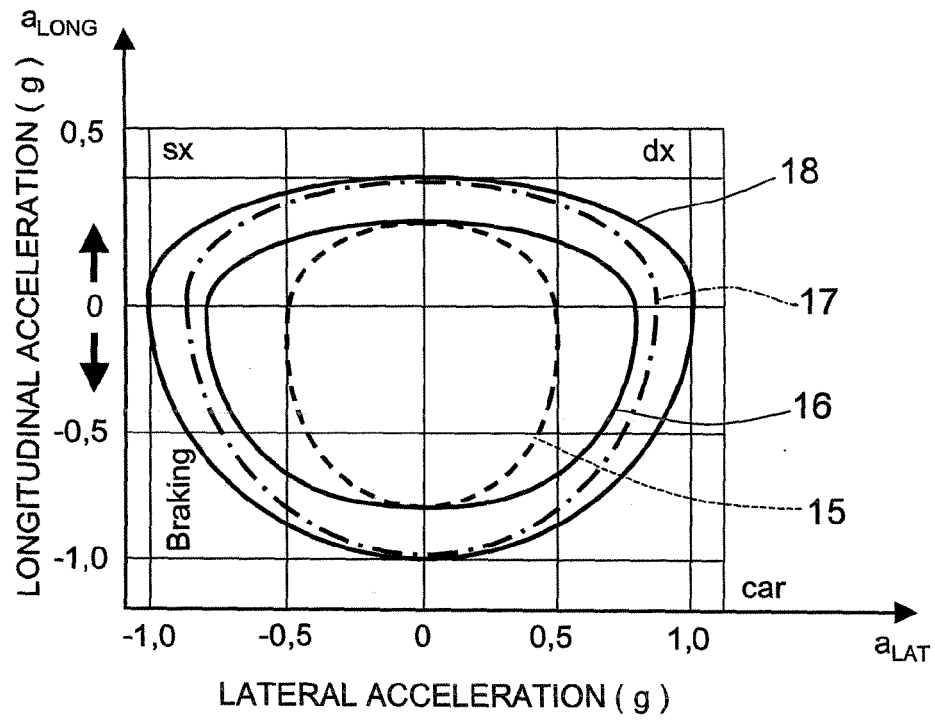


Fig.4

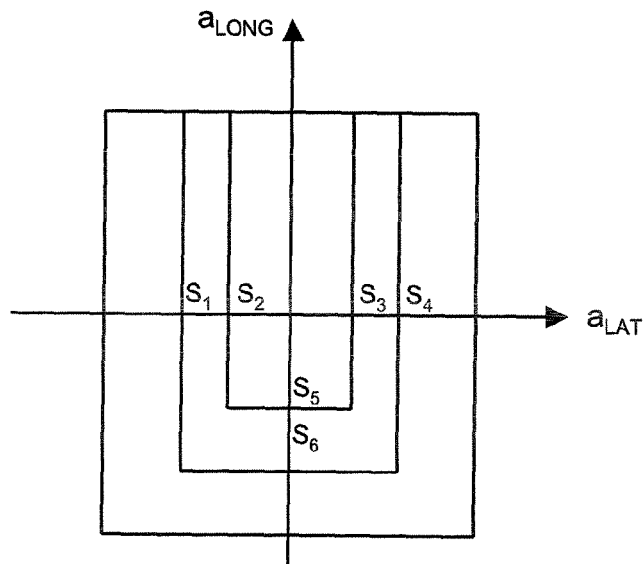


Fig.5

DATO	SOGLIA	VALORE
Threshold 3 RD LEVEL < LATERAL ACCELERATION	S ₁	- 3 m / s ²
Threshold 3 RD LEVEL < LATERAL ACCELERATION	S ₂	-1.5 m / s ²
Threshold 2 ND LEVEL > LATERAL ACCELERATION	S ₃	1.5 m / s ²
Threshold 2 ND LEVEL > LATERAL ACCELERATION	S ₄	3 m / s ²
Threshold 2 ND LEVEL LONGITUDINAL ACCELERATION	S ₅	- 2 m / s ²
Threshold 3 RD LEVEL LONGITUDINAL ACCELERATION	S ₆	- 2.7 m / s ²

Fig.6

IF $a_{\text{LONG}} \geq -2.0$ AND $-1.5 \leq a_{\text{LAT}} \leq 1.5 \Rightarrow \text{OUT} = 1^{\text{ST}} \text{ LEVEL}$
IF $-2.7 \leq a_{\text{LONG}} < -2.0$ OR $-3.0 \leq a_{\text{LAT}} < -1.5 \cup 1.5 < a_{\text{LAT}} \leq 3.0 \Rightarrow \text{OUT} = 2^{\text{ND}} \text{ LEVEL}$
IF $-\infty < a_{\text{LONG}} < -2.7$ OR $-\infty < a_{\text{LAT}} < -3.0 \cup 3.0 < a_{\text{LAT}} < \infty \Rightarrow \text{OUT} = 3^{\text{RD}} \text{ LEVEL}$

Fig.7

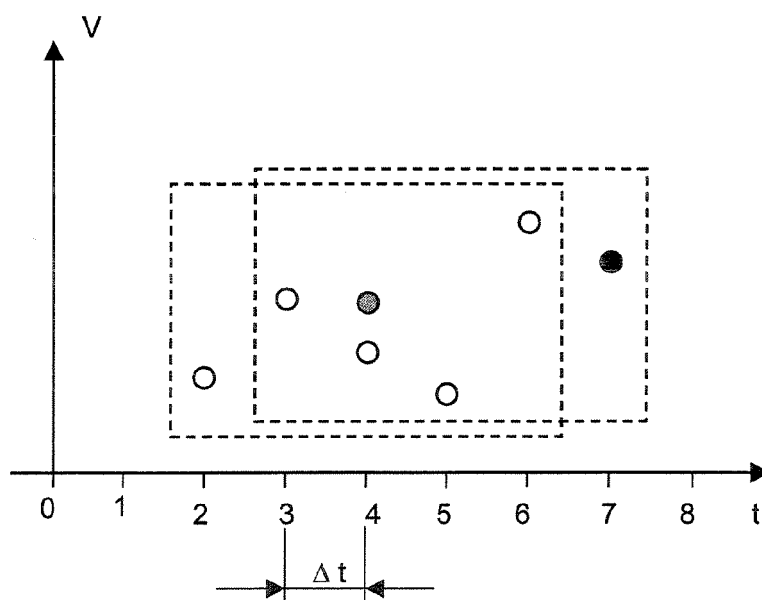


Fig.8

INPUT	STATUS	OUTPUT DSA
PHONE	PHONE CALL IN COURSE	2 ND LEVEL as the phone call starts + 2 ND LEVEL for 2 seconds after the end of the phone call
	INCOMING PHONE CALL	2 ND LEVEL when the ring tune is "on" (ring)
	SENT PHONE CALL	2 ND LEVEL for the whole period required by the connection. Then: if the phone call is accepted: see phone call in course If the phone call is refused, the line is busy or the signal is down: 2 nd LEVEL for 2 seconds after the system notification
	INCOMING TEXT MESSAGE	2 ND LEVEL for 3 seconds after the notification message
	...	...
INPUT DEVICES for the central display	PUSHBUTTON PRESSED	2 ND LEVEL for 10 seconds after the key has been pressed
	ROTARY SWITCH TURNED	2 ND LEVEL for 10 seconds after the rotary switch has been turned
	SWITCH PRESSED	2 ND LEVEL for 10 seconds after the switch has been pressed
INFOAREA in the instrument panel	MESSAGE DISPLAYED	2 ND LEVEL for the whole period of visualization of the message inside the Instruments Panel Infoarea (timeout: 20 seconds)
...	...	...

Fig.9

COMPLEXITY LEVEL	DESCRIPTION	EXAMPLES
COMPLEX OUTPUT	> 3 information units processing time > 3 seconds	Topographical representation of a route, or full route maps, etc.
SIMPLE OUTPUT	1 - 3 information units processing time < 3 seconds	Directions of turns, or estimates of travel cost

Fig.12

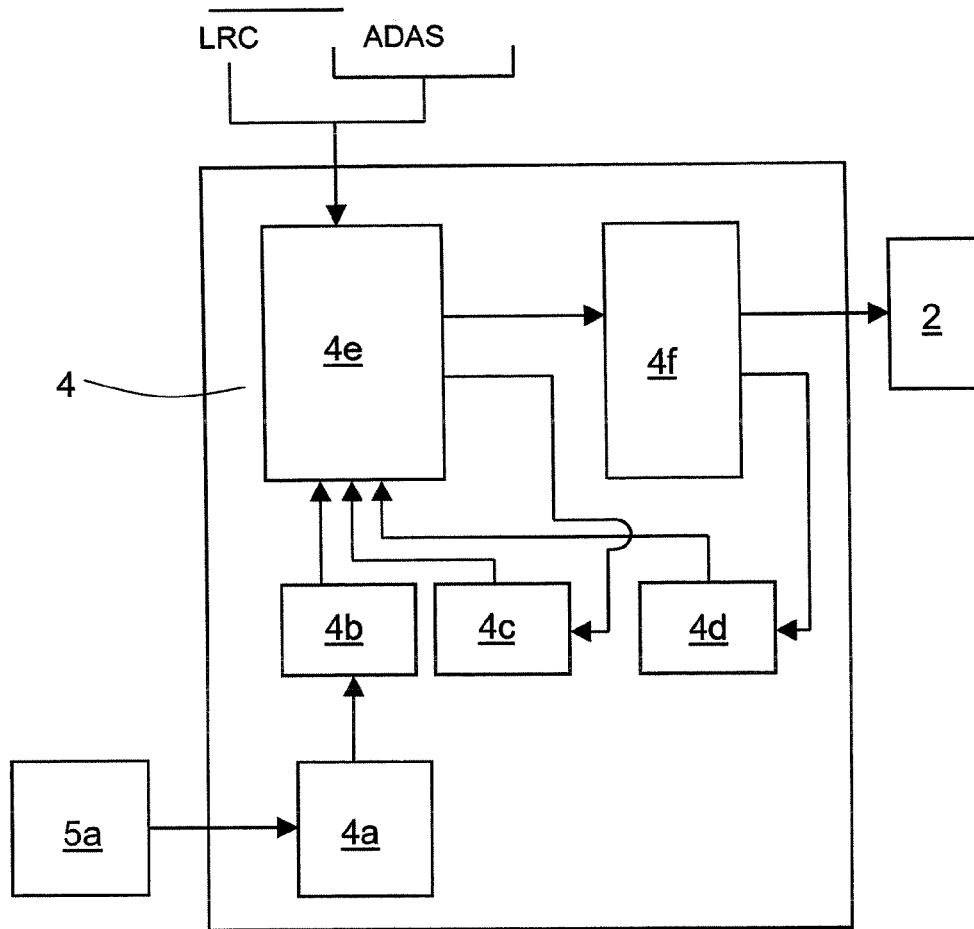


Fig.10

Interaction Matrix			New incoming message			
			Priority 1	Priority 2	Priority 3	Priority 4
Existing message	Priority 1	acoustical	simultaneously	Delayed output of priority 2 after end of priority 1 4 X seconds (if the information is still available, else it will be cancelled).	...	...
		visual	simultaneously			
	Priority 2	...	...	...	...	...

Fig.11



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 05 42 5116

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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 30 August 2005	Examiner Seisdodos, M
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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